California Department of Toxic Substances Control

Preliminary Report - February 2004

Determination of Regulated Elements in Laptop Computers and LCD Desktop Monitors for SB 20

Executive Summary

At the request of the Department of Toxic Substances Control (DTSC) Regulatory Program and Development Division (RPDD), Hazardous Waste Management Program (HWMP), the Hazardous Materials Laboratory (HML) arranged for the testing of selected waste electronic devices (e-waste) to determine the total and extractable concentrations of regulated elements for comparison with hazardous waste criteria. Two electronic product types (laptop computers and LCD monitors) were identified and, from each product type, four devices of various brands and models were collected by RPDD and submitted for analysis.

A protocol was developed to prepare these samples. Devices were dismantled individually, and components classified into millable parts [plastic casings; LCD screens; Cold Cathode Fluorescence Lamps (CCFLs); printed circuit boards (PCBoards) without capacitors or batteries], and non-millable parts (metal frames, rods, capacitors, batteries and other metal parts). The weights of all components were recorded. PCBoards and LCDs were ground to pass a 2mm sieve and mixed well. Representative sub-samples were digested using Environmental Protection Agency (EPA) Method 3050, or extracted by using either the Toxicity Characteristic Leaching Procedure (TCLP), or the California Waste Extraction Test (WET). Results were extrapolated to the entire device based on relative weights and with the assumption that non-processed components did not significantly contribute any regulated elements.

Preliminary results indicate that all the PCBoards tested clearly exceeded at least one hazardous waste criterion. Copper was the most common element exceeding its limits, followed by lead. Three more LCD monitors are being analyzed to provide additional data on these devices.

Introduction

At the request of the RPDD, HWMP, the HML arranged for the testing of electronic devices to determine the total and soluble concentrations of regulated elements for comparison with hazardous waste criteria in Title 22, Chapter 11, Article 3. Specific testing performed on the electronic devices were the TCLP; California WET, and digested with EPA Method 3050 followed by elemental testing. The results of these analytical tests were compared to hazardous waste regulatory thresholds for each analytical test: the Toxicity Characteristic regulatory level, the Soluble Threshold Limit Concentrations and Total Threshold Limit Concentrations, respectively.

Materials and Methods

Four laptop computers and four LCD monitors of different brands and models were collected by RPDD and submitted for analysis. The devices are listed in Table 1. These devices were shipped by RPDD to Sequoia Analytical Laboratories in Morgan Hill, CA where work was performed under contract # 02-T2409 under the oversight of DTSC.

Sample Preparation:

The Standard Operating Procedure (HML SOP#916-S) developed for this project is shown in Appendix A. In summary, the eight devices were dismantled individually, and components classified into the following groups:

LCD Monitors:

1) PCBoards-without any batteries or capacitors
2) LCD panels
3) CCFLs
4) Millable plastic components, plastic casings
5) Metal components (metal frames, rods, capacitors and other metal parts.).
6) Batteries

Laptop Computers-Top part

1) PCBoards-without any batteries or capacitors
2) LCD panels
3) CCFLs
4) Millable plastic components, plastic casings
5) Metal components (metal frames, rods, capacitors and other metal parts.).

Laptop Computers-Bottom part

1) PCBoards-without any batteries or capacitors
2) Millable plastic components, plastic casings
3) Metal components (metal frames, rods, capacitors and other metal parts.).

For the purpose of this phase of the study, only PCBoards, LCD panels and CCFLs were processed and analyzed. The remaining components were weighed and archived for

possible future analysis. Table 1 shows the type/brand/model of each device tested, along with the weights of each component and the total device weight.

With the exception of CCFLs (which were processed according to SOP-914S), all components to be processed were cut into small pieces and ground using a heavy duty mill (Retsch, Model #SM-2000) to achieve the desired particle size and passed through a 2mm mesh sieve. The laboratory used a 2 mm sieve for all analyses (total extractable concentrations, WET and TCLP). Milled samples were thoroughly mixed to achieve homogeneity before removing aliquots for testing.

Sample Digestion for Elemental Testing:

A one gram (1 g) representative sub-sample of the thoroughly mixed sample was digested using EPA Method 3050B, with repeated additions of nitric acid, hydrochloric acid and hydrogen peroxide till the digestion was complete.

Extraction Procedures:

Sub-samples were taken from the milled samples and were extracted using the TCLP and the WET to determine the leachability potential of regulated elements.

TCLP: An aliquot of the sample was extracted as described in EPA Method 1311. Samples were extracted with an amount of extraction fluid equal to 20 times the weight of the sample. The extraction fluid employed is a function of alkalinity of the sample. Extraction fluid #1, consisting of a mixture of acetic acid and sodium hydroxide at pH 4.93 +/- 0.05, was used, since the final pH of the samples after the addition of 1N HCl was <2.0. The extraction vessel containing the sample and the extraction fluid was agitated on a rotary shaker at 30 +/- 2 rpm for 18 +/- 2 hours at ambient temperature. The material in the extraction vessel was filtered through a glass fiber filter (0.45 micron) and the liquid extract was preserved with nitric acid to 5% by volume until ready for digestion and analysis.

WET: Sample aliquots were extracted with a citrate buffer solution (10 times the weight of the sample) at pH 5.0 for 48 hours in a mechanical shaker under anaerobic conditions. Mixtures were centrifuged, filtered through Whatman filter paper #42 and then passed through 0.45 micron membrane filter. The extracts were preserved by acidifying with nitric acid to 5% by volume before digestion and analysis.

Analytical Procedure:

The above prepared samples were digested with nitric acid, hydrochloric acid, and hydrogen peroxide, as specified in EPA Method 3050B. The digestates were analyzed by Inductively Coupled Plasma-Atomic Emission Spectrometry (ICP –AES, Thermo Jarrell Ash, Model 61E), using EPA method 6010B. According to this method, digested samples were filtered through 0.45 micron membrane filters, nebulized and the resulting aerosol transported into the plasma torch. Emission spectra were produced by radio frequency, dispersed by the grating material and the intensities of the emission lines were measured by photosensitive devices.

Hg in CCFLs:
CCFLs were processed according to SOP-914S (Appendix). Briefly, CCFLs were placed in plastic bags, frozen to minimize volatilization of Hg, crushed and homogenized. Aliquots were analyzed for Hg by EPA Method 7471A.

Preliminary Results

The elemental concentrations measured in the processed portions of the devices were converted to concentrations in the entire device by using the relative weights (Table 1), with the assumption that the unmilled portion of each device (including batteries and metal components) did not contain any of the regulated elements.

Analytical results are shown in Tables 2-5. All eight samples were analyzed for EPA Method 3050 concentrations, TCLP-extractable elements and WET-extractable elements, with the exception of two LCD PCBoards (samples LCD3 and LCD4) which were not extracted for TCLP analysis because of insufficient sample. These results are shown as not analyzed, "NA" in the respective tables. Data below the reporting limits are shown as not detected, "ND". Entries in bold face indicate results exceeding the respective regulatory thresholds (shown on the first row).

Total Concentrations

Table 2 shows the results for total concentrations in mg/Kg (extrapolated to the entire device using the relative weights of processed and non-processed portions) for all samples. TTLCs are shown in the top row. It is clear that only a few elements (Cr, Cu and Pb) were consistently measured in all samples. Concentrations were highest in Laptop PCBoards, followed by LCD monitor PCBoards. All eight PCBoard samples exceeded the TTLC for Cu. All Laptop PCBoards exceeded the TTLC for Pb and only one LCD PCBoard exceeded the TTLC for Pb. Concentrations were low in the LCD panels of all devices.

TCLP

TCLP results (mg/L extrapolated to the entire device) are shown in Table 3. Only Pb could be measured above the reporting limit. All Laptop PCBoards exceeded the TCLP for Pb. One of the two LCD PCBoards exceeded the TCLP for Pb (TCLP was not performed on the other two LCD PCBoards).

WET

Table 4 shows WET-extractable results in mg/L (extrapolated to the entire device). All samples were below the STLCs with the exception of a Laptop PCBoard exceeding the STLC for Cd.

CCFLs

Table 5 shows concentrations of Hg in CCFLs and in the entire device based on relative weights. The data indicate that whereas all CCFLs contain Hg above the TTLC, these concentrations fall below the TTLC when expressed for the entire device.

Work underway

DTSC has decided to analyze at least three more LCD monitors to obtain additional data. These additional samples are being processed and results should be available in early March 2004. These data will be combined with the data reported here and will allow more robust estimates of summary statistics.

Appendix A 1.

SOP No. 914-S

Preparation of Cold Cathode Fluorescent Lamps for Mercury Testing, including WET and TCLP

1. Scope and Application

This SOP is applicable to the preparation of cold cathode fluorescent lamps (CCFL) for mercury analysis using EPA Method 7470A, 7471A, EPA Method 1311 for TCLP, and HML Method 910-M for WET. CCFLs are commonly used in liquid crystal display (LCD) electronic devices.

2. Safety

2.1. Protective nitrile gloves and a face shield should always be worn while crushing the samples.

2.2. Crushing of the samples should always be carried out in the hood.

2.3. Samples should be wrapped in double heavy duty tear resistant plastic bags before crushing.

3. Materials and Equipment

3.1. Heavy duty hydraulic press, 40000 lb RAM force, 4" RAM (Pasadena Hydraulics, Inc.), or equivalent.

3.2. Polypropylene tear resistant plastic bags that can withstand 165 g dart test per ASTM D1709-85 (1.5 X 2 ft).

3.3. Rubber Mallet or hammer.

3.4. Sieves – No.18 mesh (1 mm opening) and No. 10 (2 mm opening).

3.5. Glass containers.

3.6. Freezer (-12 ^{0}C).

3.7. Scissors or Wire cutter.

3.8. Mortar and Pestle.

4. Procedure:

4.1. For Total Mercury , TCLP and WET Determinations

4.1.1. Cut the end cap wiring attached to the lamp with the scissors or a wire cutter. Record the weight and store separately or save the wiring with the metal fraction of the device, if appropriate, as described in HML SOP 916-S. Store samples at minus 12^0 C.

4.1.2. Weigh and record the weight of each lamp (or all lamps for a composite sample, if TCLP and or WET analysis is required) along with the end caps.

4.1.3. Place the lamp with the end caps intact into a double heavy duty polypropylene plastic bag. For longer lamps use extra long bags. Leave the sample containing bag in a freezer for one hour.

Note: Do not remove the end caps or break the sample before freezing.

4.1.4. Take the frozen sample (in the plastic bag) out of the freezer and break the lamp initially with a rubber mallet or a hammer into small pieces, then crush the lamp under the hydraulic press (if necessary).

4.1.5. Transfer the crushed samples from the plastic bag into a mortar and grind with the pestle until all the materials pass through the 1mm sieve for total Hg analysis, and use the 2mm sieve for WET & TCLP. Weigh and set aside the visible small end cap copper wire pieces.

4.1.6 Weigh and transfer the sieved sample into a glass container and store at -12^0 C.

4.1.7. Take an aliquot of 0.2 to 1.0 gram of the above prepared sample for total Hg analysis by EPA Method 7471A (or use the entire sample if necessary, to meet the detection limit criteria for this analysis). Test sub-samples in triplicate.

4.1.8. If enough sample material is available, take an aliquot of the sample from step 4.1.6 of the above procedure for WET and TCLP analysis.

4.1.9. Five to ten grams of sample may be used for WET and /or TCLP, based on sample availability. Add a proportionate amount of extracting fluids to the sample and perform WET and/or TCLP extractions as outlined in HML Method 910-S and EPA Method 1311, respectively, and determine Hg concentrations by EPA Method 7470A.

<u>Important Note</u>: For WET and TCLP, use extraction vessels that can accommodate the sample and the extraction fluid with as little head

space as possible to avoid any loss of Hg due to dissipation or evaporation.

Digest the extracts right after the extraction. Mercury may dissipate or evaporate in the head space if the extracts are stored for an extended period of time.

5. References

5.1. California Code of Regulations, Title 22, Vol. 29, Article 11, Sections 66699, 66700.

5.2. Toxicity Characteristic Leaching Procedure, Federal Register, Method 1311, SW-846.

5.3. Test Methods for Evaluating Wastes: Physical/Chemical Methods, U.S. Environmental Protection Agency, Office of Solid Waste Washington, DC, SW846, Vol. 1A, 3rd Edition, Update III.

6. Acknowledgement

This procedure was developed by the Inorganic Section of the Hazardous Materials Laboratory, Department of Toxic Substances. For more information please contact Jarnail Garcha at (510) 540-3468.

Appendix A 2.

SOP No. 916-S

Preparation of consumer electronic devices containing Liquid Crystal Displays (LCDs) for Metals, California Waste Extraction Test and Toxicity Characteristic Leaching Procedure

1 Scope and Application

1.1 This procedure is applicable to the preparation of samples of consumer electronic devices containing liquid crystal displays (LCDs) to determine the total metal content, California Waste extraction test (WET) and Toxicity Characteristic Leaching Procedure (TCLP) extractable metals in various components. For Hg testing in cold cathode fluorescent lamps (CCFLs) use HML, SOP No. 914-S.

1.2 This SOP describes the procedure to disassemble waste products, segregate components, and prepare samples prior to extraction or digestion procedures for subsequent analyses.

1.3 This procedure is recommended for use by laboratory assistants and/or technicians working under the close supervision of chemists experienced in the sample preparation requirements for inorganic analyses, and by chemists working independently.

2 Summary

2.1 Two product types of consumer electronic devices are identified: laptop computers and liquid crystal display (LCD) monitors.

2.2 The total weight of each device (sample) is recorded on Form 1. The samples are then photographed, disassembled and segregated into six major component fractions for subsequent preparation and possible analysis. These fractions are:

- 2.2.1 LCD panel
- 2.2.2 Cold Cathode Fluorescent Lamp (CCFL)
- 2.2.3 Printed circuit board
- 2.2.4 Plastics
- 2.2.5 Metal fractions
- 2.2.6 Batteries

2.3 Each component fraction is photographed, weighed and stored in separate labeled containers.

2.4 The required component fraction of a sample is shredded, milled to pass through a No.18 (1 mm) sieve, mixed for homogeneity, and then representatively sub-sampled to obtain aliquots for analysis.

Note: A No.10 (2 mm) sieve may be used for total, WET and TCLP if a No.18 (1 mm) is not available.

2.5 Particle size reduction is achieved by grinding to the required mesh size. An appropriate shredder and mill or grinder is used for this process (Retsch, Model #SM-2000, or equivalent).

2.6 Interferences from carryover from one sample to another must be minimized by thoroughly cleaning the equipment as needed. All containers must be clean and free of organic and inorganic substances. Small milling or grinding units may be cleaned as described in HML SOP 704-S.

3 Safety

3.1 Sample preparation should be performed in a well ventilated room.

3.2 Nitrile gloves may be worn for hand protection, but they must not come in contact with the sample, or the interior of the sample containers, to avoid any organic and inorganic contamination.

3.3 Use safety glasses or goggles when shredding, milling or grinding the samples.

3.4 The operator may wear a dust mask and coveralls if necessary during the process.

3.5 The work area (counters, balances, mills, equipment, tools) should be kept clean at all times.

3.6 Operating instructions must be followed while using the shredder and/or the grinder.

4 Apparatus and Materials

4.1 Hand tools: screwdrivers, electric drill/saw, cutters and pliers, etc.

4.2 Rotary mill or an automatic grinder capable of grinding hard plastics and printed circuit boards.

4.3 Sieve No. 18 (1 mm).

4.4 Electric cutter or a shredding machine capable of reducing particle size of the material into small pieces.

4.5 Top loading balance 20 Kg capacity (accurate to +/-1.0 g).

4.6 Top loading balance 1 Kg capacity (accurate to +/- 0.2 g).

4.7 Dust masks, face shields or eye goggles.

4.8 Nitrile gloves.

4.9 Teflon or glass containers of appropriate size for storing the prepared samples.

4.10 Liquid nitrogen

4.11 De-ionized water

4.12 Nitric acid, 5 percent

4.13 Acetone

5 Disassembly/Separation Procedure

5.1 Remove all external electrical cords and computer cables.

5.2 Label each sample, photograph, weigh and record weight using Form 1.

5.3 Unhinge and separate computer laptop samples into two samples, the LCD panel (i.e. the top part) and the Computer Processing Unit (i.e. the bottom part). Note: This may require disassembly and reassembly of the top portion of the laptop. Keep all component fractions of top and bottom parts separately. Assign suffix “B” for bottom and “T” for top parts to the ID number assigned to the device. From this point forward the top part (the LCD panel) will be analyzed as an LCD device sample.

5.4 Dismantle each sample and separate into its major component fractions, namely:

- 5.4.1 LCD panel
- 5.4.2 Cold Cathode Fluorescent Lamp (CCFL)
- 5.4.3 Printed circuit board
- 5.4.4 Plastics
- 5.4.5 Metal fractions
- 5.4.6 Batteries

5.5 Remove extraneous material, like nuts, screws, loose wires, and metal brackets and include with the metal component fraction.

5.6 Cold Cathode Fluorescent Lamp (CCFL) component fractions are photographed, weighed and prepared in accordance with SOP 914-S and analyzed.

5.7 Printed circuit board fractions are photographed, weighed and stored in properly identified containers.

5.8 Plastic components are photographed, weighed and stored in properly identified containers.

5.9 Metal components (including metal brackets, screws and wires) are photographed, weighed and stored in properly identified containers.

5.10 Batteries are weighed and stored separately.

6 Size Reduction Procedure

6.1 The entire sample component fraction slated for analysis (i.e., LCDs or circuit boards) is size-reduced by cutting/shredding and milling.

6.2 The milling equipment is fitted with a 1 mm sieve (2 mm sieve may be substituted) and the entire sample component fraction is processed.

6.3 Clean the shredder (wear mask and/or goggles) after processing each component fraction. Inspect to ensure the shredder is completely free of particles.

6.4 Process at least 10g of plastic chips, or other equipment blank material, for analysis to check for cross-contamination.

6.5 Collect the sieved sample, record weight on Form 1 and store in a properly labeled container.

6.6 Appropriate aliquots of the milled material are taken for metals, TCLP and WET determinations.

7 Quality Control

7.1 Although most of the QC requirements are defined in the respective analytical procedures, at a minimum, the following quality checks are required.

7.2 A sample batch is defined as a group of 10 samples [excluding LCS (laboratory control sample), MS (matrix spike) and MSD (matrix spike duplicate)] or less, that is processed together and that is comprised of similar component fractions (i.e. circuit board fractions or LCD Panel fractions).

7.3 A sample batch must consist of samples of the same matrix processed and digested/extracted and analyzed at the same time. Any other type of matrix QC included with the samples is not acceptable.

7.4 Each batch shall contain one method blank. The blank shall contain all reagents processed with that batch.

7.5 Each batch must include a replicate (sample duplicate).

7.6 Each batch shall contain an MS and an MSD.

7.7 Each batch shall contain a method standard or LCS containing all elements/compounds of concern.

7.8 Either the LCS or the MS/MSD (or both) must be prepared from secondary source standards. (i.e., the source must differ from the calibration standards by lot # at a minimum.)

8 References

8.1 California Code of Regulations, Title 22, Section 66261.20

8.2 HML, SOP 914-S

8.3 HML, SOP 704-S

8.4 Toxicity Characteristic Leaching Procedure, Federal Register, Method 1311, SW-846.

8.5 Test Methods for Evaluating Wastes: Physical/Chemical methods, US Environmental Protection Agency, Office of Solis Waste, Washington, DC, SW-846, Vol.1A, 3rd Edition, Update III.

9 Acknowledgement

This procedure was developed by the Hazardous Materials Laboratory, and the Waste Identification and Recycling Unit of the Department of Toxic Substances Control. For more information please contact Jarnail Garcha at (510) 540-3468.

Table 1. Weights of entire device and components in grams

Type	Brand	Model	Panel (g)	PC Board (g)	CCFL (g)	Plastic parts (g)	Metal parts (g)	Battery (g)	Total device (g)
LCD-1	NEC	Multi Sync LCD 1810 XtraView	800.00	598.21	8.99	1379.20	2378.30		5164.70
LCD-2	Mitsubishi	LXA565W	761.82	352.40	3.40	1022.50	2590.50		4730.62
LCD-3	Mitsubishi	LXA565W	778.08	345.88	3.33	1009.80	2659.77		4796.86
LCD-4	Sony	SDM-M81	1769.85	66.04	12.50	1681.90	3361.99		6892.28
Laptop-1	Toshiba	Satellite Pro 400CDT	360.10	541.37	1.59	972.70	1015.20	41.62	2932.58
Laptop-2	Toshiba	Satellite	347.43	502.92	1.62	885.35	721.22	598.79	3057.33
Laptop-3	Toshiba	Satellite T 2130CT	384.28	467.65	0.99	826.26	642.43	40.61	2362.22
Laptop-4	Compaq	Presario 1277	438.19	295.65		353.36	1547.80	411.58	3046.58

Table 2. Total Concentrations in mg/kg of entire device

Collector's ID		Type of Sample	Wt of part	Wt of Device	TTLC= Factor= Part/ Device	500 Sb	500 As	10,000 Ba	75 Be	100 Cd	2,500 Cr	8,000 Co	2,500 Cu	1,000 Pb	3,500 Mo	2,000 Ni	100 Se	500 Ag	700 Th
LCD-1	MML0779-01	LCD Panel	800	5,165	0.155	ND	2	ND	ND	ND	10.7	ND	94	ND	ND	ND	ND	ND	ND
LCD-2	MML0779-07	LCD Panel	762	4,727	0.161	ND	ND	ND	ND	ND	3.9	ND	ND	ND	ND	ND	ND	ND	ND
LCD-3	MML0779-13	LCD Panel	778	3,719	0.209	ND	ND	ND	ND	ND	7.3	ND	ND	ND	ND	ND	ND	ND	ND
LCD-4	MML0779-19	LCD Panel	1,770	6,892	0.257	ND	4	ND	ND	ND	5.9	ND	ND	ND	10	ND	ND	ND	ND
Laptop-1T	MML0779-25	LCD Panel	360	2,571	0.140	NA	2	54	ND	ND	4	ND	5	ND	4	2	ND	ND	ND
Laptop-2T	MML0779-43	LCD Panel	347	3,057	0.114	ND	66	83	ND	ND	92	ND	ND	ND	ND	ND	ND	ND	ND
Laptop-3T	MML0779-55	LCD Panel	384	2,362	0.163	ND	27	60	ND	ND	63	ND	ND	ND	ND	ND	ND	3	ND
Laptop-4T	MML0779-67	LCD Panel	438	3,047	0.144	ND	ND	ND	ND	ND	3	ND	345	13	ND	ND	ND	20	ND
LCD-1	MML0770-03	PCBoard	598	5,165	0.116	79	ND	394	ND	ND	8	ND	**13,894**	**1,065**	ND	162	ND	35	4
LCD-2	MML0779-09	PCBoard	352	4,727	0.074	39	ND	1,500	ND	ND	4	6	**13,404**	745	ND	89	ND	42	ND
LCD-3	MML0779-15	PCBoard	346	4,797	0.072	56	ND	332	ND	ND	16	ND	**12,262**	793	ND	238	ND	39	ND
LCD-4	MML0779-21	PCBoard	66	6,892	0.010	2	ND	56	ND	ND	ND	ND	**3,447**	60	ND	34	ND	3	ND
Laptop-1B	MML0779-27	PCBoard	541	2,571	0.210	337	ND	505	ND	ND	12	10	**44,189**	**1,515**	ND	1,326	ND	101	ND
Laptop-2B	MML0779-39	PCBoard	503	3,057	0.165	142	ND	872	ND	ND	56	ND	**36,199**	**1,333**	ND	790	ND	97	ND
Laptop-3B	MML0779-51	PCBoard	468	2,362	0.198	277	ND	674	ND	ND	9	ND	**57,460**	**2,180**	ND	1,030	ND	48	ND
Laptop-4B	MML0779-63	PCBoard	296	3,047	0.097	117	ND	544	ND	ND	30	ND	**16,515**	**1,069**	43	952	ND	20	ND

Table 3	Concentrations of TCLP-extractable elements (in mg/L) of entire device.											
						5	**100**	**1**	**5**	**5**	**1**	**5**
Collector's ID		**Type of Sample**	**Wt of part**	**Wt of Device**	**Factor= Part/Device**	**As**	**Ba**	**Cd**	**Cr**	**Pb**	**Se**	**Ag**
LCD-1	MML0779-01	LCD Panel	800	5165	0.155	ND	ND	ND	ND	ND	ND	ND
LCD-2	MML0779-07	LCD Panel	762	4727	0.161	ND	ND	ND	ND	ND	ND	ND
LCD-3	MML0779-13	LCD Panel	778	3719	0.209	ND	ND	ND	ND	ND	ND	ND
LCD-4	MML0779-19	LCD Panel	1770	6892	0.257	ND	ND	ND	ND	ND	ND	ND
Laptop-1T	MML0779-25	LCD Panel	360	2571	0.140	ND	ND	ND	ND	ND	ND	ND
Laptop-2T	MML0779-43	LCD Panel	347	3057	0.114	ND	ND	ND	ND	ND	ND	ND
Laptop-3T	MML0779-55	LCD Panel	384	2362	0.163	ND	ND	ND	ND	ND	ND	ND
Laptop-4T	MML0779-67	LCD Panel	438	3047	0.144	ND	ND	ND	ND	1.72	ND	ND
LCD-1	MML0770-03	PCBoard	598	5165	0.116	ND	ND	ND	ND	0.2	ND	ND
LCD-2	MML0779-09	PCBoard	352	4727	0.074	ND	ND	0.04	ND	**27.6**	ND	ND
LCD-3	MML0779-15	PCBoard	346	4797	0.072	NA	NA	NA	NA	NA	NA	NA
LCD-4	MML0779-21	PCBoard	66	6892	0.010	NA	NA	NA	NA	NA	NA	NA
Laptop-1B	MML0779-27	PCBoard	541	2571	0.210	ND	ND	ND	ND	**75.8**	ND	ND
Laptop-2B	MML0779-39	PCBoard	503	3057	0.165	ND	ND	0.0296	ND	**57.6**	ND	ND
Laptop-3B	MML0779-51	PCBoard	468	2362	0.198	ND	ND	0.0277	ND	**81.2**	ND	ND
Laptop-4B	MML0779-63	PCBoard	296	3047	0.097	ND	ND	ND	ND	**22.3**	ND	ND

Table 4 Concentrations of WET-extractable elements (in mg/L) of entire device.

							5	100	175	1	5	80	25	5	350	20	1
Collector's ID		**Type of Sample**	**Wt of part**	**Wt of Device**	**Factor = Part/Device**	**Al**	**As**	**Ba**	**Be**	**Cd**	**Cr**	**Co**	**Cu**	**Pb**	**Mo**	**Ni**	**Se**
LCD-1	MML0779-01	LCD Panel	800	5165	0.155	0.3	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
LCD-2	MML0779-07	LCD Panel	762	4727	0.161	0.0	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
LCD-3	MML0779-13	LCD Panel	778	3719	0.209	0.2	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
LCD-4	MML0779-19	LCD Panel	1770	6892	0.257	0.2	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Laptop-1T	MML0779-25	LCD Panel	360.1	2571	0.140	0.0	ND	0.5	ND	ND	0.1	ND	0.2	ND	0.2	ND	ND
Laptop-2T	MML0779-43	LCD Panel	347	3057	0.114	0.4	ND	ND	ND	ND	ND	ND	0.1	ND	ND	ND	ND
Laptop-3T	MML0779-55	LCD Panel	384	2362	0.163	0.4	ND	ND	ND	ND	ND	ND	0.2	ND	ND	ND	ND
Laptop-4T	MML0779-67	LCD Panel	438	3047	0.144	0.1	ND	ND	ND	ND	ND	ND	0.8	**6.0**	ND	ND	ND
LCD-1	MML0770-03	PCBoard	598	5165	0.116	1.4	ND	2.1	ND	ND	ND	ND	ND	0.3	ND	ND	ND
LCD-2	MML0779-09	PCBoard	352	4727	0.074	0.8	ND	1.2	ND	0.1	ND	ND	ND	0.3	ND	1.0	ND
LCD-3	MML0779-15	PCBoard	346	4797	0.072	0.6	ND	0.7	ND	ND	ND	ND	ND	ND	ND	ND	ND
LCD-4	MML0779-21	PCBoard	66	6892	0.010	ND	ND	0.2	ND	ND	ND	ND	ND	1.0	ND	ND	ND
Laptop-1B	MML0779-27	PCBoard	541	2571	0.210	1.1	ND	3.4	ND	ND	ND	ND	ND	ND	ND	ND	ND
Laptop-2B	MML0779-39	PCBoard	503	3057	0.165	0.7	ND	2.1	ND	**22.0**	ND	ND	ND	ND	ND	ND	ND
Laptop-3B	MML0779-51	PCBoard	468	2362	0.198	3.6	ND	2.4	ND	ND	ND	ND	ND	ND	ND	ND	ND
Laptop-4B	MML0779-63	PCBoard	296	3047	0.097	0.5	ND	2.1	ND	ND	ND	ND	ND	0.3	ND	ND	ND

Table 5 **Concentrations of Hg (mg/kg) in CCFL and in entire device assuming no Hg presence in any other component.**

CCFL	ID	CCFL WT (g)	Hg in CCFL (mg/Kg)	DEVICE WT (g)	Factor= Part/Device	Hg in DEVICE (mg/Kg)
LCD1	779-02	8.99	110	5165	0.00174	0.19
LCD2	AN00852	3.4	337	4727	0.00072	0.24
LCD3	779-14	3.33	520	4797	0.00069	0.36
LCD4	779-20	12.50	32	6892	0.00181	0.06
LAPTOP1	AN00853	1.59	220	2933	0.00054	0.12
LAPTOP2	779-44	1.62	300	3057	0.00053	0.16
LAPTOP3	779-56	0.99	440	2362	0.00042	0.18
LAPTOP4	NA					